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Resource Factors of Intellectual Development in Younger Bilingual Students

Ekaterina G. Budrina[a] *

[a]*The Institute of Psychology of Russian Academy of Sciences, 13/1 Yaroslavskaya street, Moscow 129366, Russian Federation*

Abstract

Our study aims to analyze the intellectual development of younger schoolchildren and identify the structure of intelligence in bilinguals and monolinguals. In order to define features of intelligence WISC, Toulouse-Pieroni test and Bender test were used. Also educational achievements were estimated. It is shown that under the same academic achievements bilinguals and monolinguals have differences in intellectual development. It was found that bilingual and monolingual schoolchildren have different structure of intelligence. The results of the factor analysis revealed insufficient differentiation of mental functions, "chaos" in the organization of mental experience in younger bilingual and monolingual schoolchildren.

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Keywords: intellectual development, resource, bilingual education, younger school age, bilinguals, monolinguals;

1. Introduction

Integration of cultures is a global factor of modern world and spread all over the world. Migratory movements inevitably lead to the integration of languages that result in appearance several problems, one of which is bilingual education. Native language is the only natural means of communication for the child in linguistically homogeneous (monolingual) society, but immigrant children, whose number is large in the modern society in all developed countries, are constantly faced with the problem of choice of language for the current situation of communication, as well as the necessity of imperative assimilation and improvement of a new language (Glozman, 2009).

Native language is not "innate" language neither language of parents, especially if his/her family is mixed. Native language in general words is the language in which a child uttered his/her first words. Non-native language learned

* Ekaterina G. Budrina. Tel.: +7-964-558-0962.
E-mail address: bydrina@yandex.ru

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by a child may be in turn of two types. If it is the language spoken in the community in which children develop we usually call it as a second language. If there are no or virtually no speakers of that language in the language environment of child - it is foreign language (Leont'ev, 1999).It should be distinguished from the dominant language – it is a language, most closely associated with the development of personality and mental processes (especially thinking) in a child in this age period and general mental development. These languages may not coincide.

There are two kinds of nonnative language learned by a child. The Second language is the one that is used in that community in which child develops.Foreign language- when there is no native speakers of this language in the language environment (Leontiev, 1999).

L.S. Vygotsky (1999) believed that knowledge of foreign languages is useful not only in itself but also because it helps to understand semantics of native language. He also points out that foreign languages should be mastered by child parallel to native language or (in later ontogeny) with some time shift. If there is an ability to adequately express the idea in their native language, bilingualism will be mastered more easily. L.S.Vygotsky (1999) notes that the process of becoming bilingual depends on the variety, depth and accuracy of speech knowledge that a child receives from communication with adults in early childhood.

Children's multilingualism become possibly as a result of some plastic reconstructions of brain under the influence of needs to communicate in two or more languages. However, all scenarios of mastering two languages in early childhood show a strong tendency towards to monolingualism. Some authors (Porsche, Pallier & Jampert, 2002) believe that immersion in a new language environment of the child, already speaking the same language, this trend is reflected in the decrease or complete loss of the first language. The simultaneous development of two languages shows the same trend: if intensity of communication in one language is reduced for some reason this language will be quickly forgotten (Montanari, Kielhofer & Jonekeit). Only coexistence of two language environments (naturally or artificially created for child for a long time) leads to full bilingualism and allows saving it. It seems that brain plasticity is aimed, on the one hand, to address the critical needs of communication, and on the other hand, tends to the economical use of its resources and return to the original (monolingual) program.

If when during monolingual's training, we have seen consistent improvement of language in the child, but during bilingual education there are two opposing trends - improving language and its simplification.

Earlier there was an idea that bilingualism has a negative impact on child's development (the origins of this representation are related to the fact that immigrant children were tested in a second language). But now it is proven that bilingualism promotes more flexible thinking, helps to approach the problem from different angles and different perspectives, and expands cognition. The positive impact effects of assimilation of two language systems (the ability to read in two languages) on formation of cognitive functions in children is were demonstrated (Schwartz, Leikin, Share, 2005).

Studying foreign language, the student must learn new names for objects and phenomena, to redistribute the volume values, to highlight new concepts, different structure picture of the world. This new knowledge affects the ability of expression of personality. Therefore, learning a non-native language as well as learning by means of foreign language leads to a new sense of self, a new identity. It is mastering of other spaces of communication (Wiesel & Konstantinov, 2014).

The number of children applying for admission to the school (including pupils bilingual), is characterized by considerable heterogeneity in terms of their intellectual development. Schooling imposes the same requirements for all children, however, among students-bilingual which are at the same level of intelligence, some of them experiencing significant learning difficulties, and others successfully cope with them. Thus the question is: what are those resource-factors of intellectual development that characterize successful bilingual students?

In our study, to determine the level of intellectual development of Junior schoolchildren used Wechsler test (Wechsler Intelligence Scale for Children, full version). For estimation of educational achievements were taken into account three indicators of academic success (the average score in language and mathematics; the average score for all subjects; reading). In addition, we applied methods of diagnosis of vision-motor coordination, speed of information processing and attention.

2. Procedures and Methods

2.1. Participants

There were 94 primary school students participated in investigation, 36 of them were bilingual schoolchildren (19 boys and 17 girls) and 58 – monolingual (32 boys and 26 girls). The average age of the subjects was 8 years, 7 months.

2.2. Methods

In order to define the level of intellectual development of young schoolchildren Wechsler test (children's option, full version) was used. Three indicators of educational achievements (grade point average of language and mathematics, grade point average of all subjects; reading skills) were taken into account to assess the educational achievements. Methods developed by Toulouse-Pieroni, Bender were used to estimate visual-motor coordination, speed of information processing and attention.

Statistical methods for processing of empirical data included descriptive statistics, parametric methods to identify differences and factor analysis. Mathematical processing of the data was performed using the SPSS 19.

3. Results and Discussions

3.1. Comparative analysis of intelligence of younger bilingual students and younger monolingual students

According to our data (Table. 1), younger monolingual students have significant differences compared with bilinguals on indicators of verbal (T = -4.625 ***), nonverbal (T = -3.618 ***) and general intelligence (T = -5.242 ***). Values of verbal, nonverbal, and general intelligence of bilingual schoolchildren are within 90-109. This corresponds to the average level of intelligence. Values of verbal, nonverbal, and general intelligence of monolingual schoolchildren are within 110-119. This corresponds to the high average level of intelligence.

Younger students monolinguals have advantages in terms of intelligence in comparison with bilinguals not just on the verbal scale sub-tests as Information (T=-5,119***), Comprehension (T=-3,903***), Similarities (T=-4,239***), Vocabulary (T=-4,164***), what is predictable, but also on some nonverbal scale subtests namely Picture Completion (T=-2,034*), Picture Arrangement(T=-2,013*), Block Design (T=-4,060***) and Mazes (T=-3,165***).

Additional techniques used for diagnostic hand-eye coordination, speed of information processing and attention did not reveal significant differences in the tested groups.

It should be noted that these groups of monolingual and bilingual students are equally academically successful. In evaluation of three educational achievements indicators (grade point average of language and mathematics, grade point average of all subjects; reading skills) no significant differences were recorded.

Table 1. Indicators of intelligence of bilingual and monolingual younger schoolchildren

№	Indicators	Bilinguals		Monolinguals		Student
		M	σ	M	σ	T-test
1	Information	10,03	3,308	13,47	2,921	-5,119***
2	Comprehension	13,39	3,736	16,26	2,977	-3,903***
3	Arithmetic	10,22	2,758	9,52	3,169	1,137
4	Similarities	9,67	3,439	12,74	3,385	-4,239***
5	Vocabulary	6,69	2,896	9,34	3,160	-4,164***
6	Digit Span	8,86	2,072	9,24	2,105	-0,860
7	Picture Completion	12,33	2,767	13,52	2,703	-2,034*
8	Picture Arrangement	11,08	3,358	12,48	3,141	-2,013*
9	Block Design	11,44	3,333	14,19	2,935	-4,060***
10	Object Assembly	3,58	2,999	4,50	2,466	-1,539
11	Coding	11,47	2,813	12,50	3,186	-1,636
12	Mazes	10,81	3,188	12,78	2,471	-3,165***
	Verbal IQ	98,64	12,922	110,86	11,669	-4,625***
	Nonverbal IQ	101,31	14,473	111,52	11,164	-3,618***
	Full IQ	99,64	11,861	112,40	10,811	-5,242***
	Average of language and mathematics	3,95	0,590	4,19	0,620	-1,812
	Average of all subjects	4,25	0,483	4,40	0,521	-1,451
	Reading skills	2,06	2,042	6,38	17,422	-1,869
	Hand-eye coordination	11,44	3,065	14,88	15,817	-1,606
	Speed of information processing	39,75	10,475	43,83	13,796	-1,624
	Attention	0,90	0,108	0,92	0,057	-1,153

Further, we divided the group of bilinguals and monolinguals into successful and unsuccessful students. The group of unsuccessful students bilingual and monolingual amounted students whose Average score on language and mathematics or Average scores on items amounted to 3-3,8 points. The rest of the students entered the group of successful bilingual and monolingual schoolchildren. The group of unsuccessful bilingual amounted to 10 students (7 boys and 3 girls), the group of successful bilingual amounted to 26 students (12 boys and 14 girls). Unsuccessful monolinguals totaled 12 students (8 boys and 4 girls). Successful monolinguals totaled 46 students (24 boys and 22 girls).

Table 2.Indicators of intelligence of successful and unsuccessful younger schoolchildren (bilingual and monolingual)

№	Indicators	Bilinguals		Monolinguals	
		unsuccessful	successful	unsuccessful	successful
1	Information	9,80	10,12	12,67	13,67
2	Comprehension	12,80	13,62	15,50	16,46
3	Arithmetic	9,70	10,42	10,92	9,15
4	Similarities	9,30	9,81	12,75	12,74
5	Vocabulary	6,20	6,88	8,58	9,54
6	Digit Span	8,40	9,04	8,00	9,57
7	Picture Completion	12,80	12,15	13,67	13,48
8	Picture Arrangement	11,50	10,92	12,33	12,52
9	Block Design	12,40	11,08	13,42	14,39
10	Object Assembly	3,80	3,50	4,00	4,63
11	Coding	12,30	11,15	13,08	12,35
12	Mazes	11,00	10,73	12,58	12,83
	Verbal IQ	96,20	99,58	108,50	111,48
	Nonverbal IQ	104,00	100,27	109,92	111,93
	Full IQ	100,10	99,46	110,08	113,00
	Average of language and mathematics	3,20	4,25	3,29	4,42
	Average of all subjects	3,66	4,47	3,61	4,60
	Reading skills	1,10	2,42	1,75	7,59
	Hand-eye coordination	9,50	12,19	10,92	15,91
	Speed of information processing	39,37	39,90	49,35	42,40
	Attention	0,85	0,92	0,88	0,93

According to the data (table.2), in tested groups of successful and unsuccessful younger students bilingual and monolingual, besides of obtained significant differences in Average scores on language and mathematics (in the bilingual group T=-8,046***, in the group monolingual T=-11,400***) and the Average scores on subjects (group bilingual T=-7,198***, in the group monolingual T=-8,748***), that was predictable, we revealed significant differences in one of the indicators academic achievement - i.e.in Reading skills (in the bilingual group T=-2,031*, in the group monolingual T=-2,009*).

Successful students have advantages in the bilingual group compared with the unsuccessful students on the indicator of hand-eye coordination (T=-3,179**).Unsuccessful students in the monolingual group have advantages compared to successful students in scores of Speed of information processing (T=2,261*). According to Wechsler test no significant differences were detected on any indicator in tested groups. In other words both successful and unsuccessful students (both bilingual and monolingual ones) do not have differences in intellectual development.

3.2. The factor analysis of intelligence indicators of bilingual and monolingual students

As a rule, factor analysis of intelligence using the Wechsler test lead to allocation of three factors: Verbal comprehension, Spatial organization and Working memory / Attention. Verbal comprehension factor is an indicator of crystallized intelligence (gC). It includes such Wechsler subtests as Information, Comprehension, Similarities and Vocabulary. The factor "Spatial organization" considered as a measure of fluid intelligence (gF). It is consisted of such subtests as Block Design, Object Assembly and Picture Arrangement. Memory / Attention factor is considered as a measure of working memory. It includes such subtests as Arithmetic and Picture Completion (Parker 1983; Leckliter et al., 1986; Kaufman, Lichtenberger , 2006; Hunt, 2011).

In table 3 there are results of factor analysis of subtests of the scale of the Wechsler test for bilingual students.

Table 3. The results of factor analysis of subtests of the scale of the Wechsler test for bilingual students

Indicators	Rotated component matrix Factors			
	1 (32,6%)	2 (16,8%)	3 (12,9%)	4 (8,9%)
Information		0,720		
Comprehension		0,744		
Arithmetic		0,773		
Similarities		0,602		
Vocabulary		0,752		
Digit Span				0,862
Picture Completion			0,751	
Picture Arrangement	0,686			
Block Design	0,827			
Object Assembly	0,838			
Coding			0,753	
Mazes	0,657			

Method of selection: by principal components method.
Rotation method: Varimax with Kaiser normalization.
a. Rotation converged in 6 iterations.

According to Table 3 four factors that explain 71.2% of total variance were allocated. The content analysis of these factors shows that the first factor Spatial *organization* (explains 32.6% of the variance) plays dominant role for bilingual students. The second factor, Verbal comprehension, (16.7%) included along with the traditional verbal subtests (*Information*, *Comprehension*, *Similarities*, *Vocabulary*) also *Arithmetic*, which characterizes the *Working memory.* In the third factor entered the subtests *Picture Completion* and *Coding*, while subtest of *Digit Span*s was extracted into the fourth separate factor. As we can see, in the same factor together were presented indicators both of crystallized and of fluid intelligence (the second factor). At the same time, another indicator of working memory ("*Digit Span*") was isolated (into the fourth factor). This distribution of indicators implies lack of differentiation between verbal and attention abilities in the structure of intelligence in bilingual schoolchildren.

Table 4.The results on the factor analysis of intelligence indicators in monolingual students

Rotated component matrix				
Indicators	Factors			
	1 (28,2%)	2 (12,0%)	3 (10,0%)	4 (9,0%)
Information	0,667			
Comprehension	0,603			
Arithmetic			0,608	
Similarities	0,684			
Vocabulary	0,788			
Digit Span		0,730		
Picture Completion		0,584		
Picture Arrangement			0,651	
Block Design		0,662		
Object Assembly				0,670
Coding			0,777	
Mazes				0,801
Method of selection: by principal components method.				
Rotation method: Varimax with Kaiser normalization.				
a. Rotation converged in 7 iterations.				

According to Table 4, four factors in the structure of intelligence in bilingual schoolchildren were distinguished. They explain 59.3% of the total variance (the first factor explains 28.2% of the variance, the second factor - 12.04%, the third factor - 10.01%, the fourth factor - 8.98%).

A content analysis of these factors shows that monolingual schoolchildren tend to structuring of verbal abilities. This tendency manifests itself in the fact that all four subtests (Information, Comprehension, Similarities, and Vocabulary) fall into one factor called Verbal comprehension. However, indicators of subtests that characterize such intelligence components as Spatial organization and Working memory / Attention appear in different factors. This indicates low differentiation between spatial, mnemonic and attention abilities in monolingual schoolchildren.

4. Conclusion

The results of the comparative analysis showed that bilingual and monolingual young schoolchildren have differences in intellectual development under the same educational achievements. However, successful and unsuccessful students within each group have no differences in intellectual development at under various educational achievements and reading skills.

The results of the factor analysis showed a different structure of intelligence in bilingual and monolingual schoolchildren. Distribution of indicators in the structure of intelligence in bilingual schoolchildren indicates a lack of differentiation of verbal and attention abilities. Also a tendency for structuring spatial abilities is presented. Monolingual schoolchildren have low differentiation between spatial, mnemonic and attention abilities and a tendency for structuring of verbal abilities. This distribution of subtests indicators suggests a lack of differentiation of mental functions. There is "chaos" in the organization of mental experience of younger bilingual and monolingual schoolchildren.

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